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which *T. sericodon* was first discovered by Dr. H. C. Wood in Southern New Jersey, and *T. sicaria* by Philip T. Tyson in Southern Maryland. In both localities their remains are mingled with those of Dolphins and Whales, and their carcasses have all floated together on the ocean currents and tides to their present resting places. In Europe there are some species of the same genus, while allies of the true crocodilian form represent the Plerodon of Meyer. The gavials of the Cretaceous present a similar character of teeth, and approach remarkably near to the Thecachampsæ, when we consider the great hiatus between the life of the two great periods in other departments. The gavials of the Miocene differ in but a few important points from the Thoracosauri of the Cretaceous. The latter were very numerous in individuals, and appear under five specific forms.

In the plate accompanying this article, the artist has attempted an ideal representation of a few of the subjects which haunted the shores of our country, when our prairies were the ocean bottom, and our southern and eastern borders were far beneath the Atlantic. *Laelaps aquilunguis* occupies the foreground on a promontory, where his progress is interrupted by the earnest protest of an *Elasmosaurus*. *Mosasauros* watches at a distance with much curiosity and little good will, while *Osteopygis* views at a safe distance the unwonted spectacle. On the distant shore a pair of the huge *Hadrosauri* browse on the vegetation, squatting on their haunches and limbs as on a tripod. *Thoracosaurus* crawls up the banks with a fish, and is ready to disappear in the thicket.

INSECTS INJURIOUS TO THE POTATO.

BY HENRY SHIMER, M. D.

Of the several distinct species of potato bugs, the Colorado Beetle (*Doryphora 10-lineata* Say, Fig. 13 ; *a*, eggs ; *b*,

young and fully grown larvæ ; *c*, pupa ; *d*, beetle ; *e*, left wing cover, magnified ; *f*, leg, magnified) has chiefly attracted attention at the West during the few years past. It has been very destructive, hence anything bearing upon its habits is

Fig. 13.



interesting to farmers. Last year they were more numerous in Illinois than at any other time. Whole acres were entirely destroyed by them. The autumn following the early frosts that killed the potato vines, was one of the finest we ever enjoyed. This unusually late pleasant weather induced the pupæ of the last brood of the Colorado Beetle to mature and come out of the ground instead of remaining in over winter, and the lack of food in the fall, together with the cold open winter, contributed greatly to their destruction. From this one can easily see their assailable points, and devise means for holding them in check. It is manifest that this can be done most effectually by the concerted action of the farmers of the whole country. I think it needs no argument to prove that it would be better for the entire North-west, so far as the Colorado Beetle has extended, to abstain from planting potatoes for one year, than to be annoyed as they have been in Iowa and Illinois during the few past years. Or, perhaps, it might be as effectually managed by planting only early-

maturing varieties ; planting these early one year, and digging the potatoes in August ; then in the following year farmers might plant about the first of July, and take them up after the frost kills the vines. By this course of treatment these potato bugs will be without food during the first fall, and many will perish, while those that remain in the ground over winter will come up in May, and be without food more than a month in the spring, and thus perish. This plan rigidly followed will restrain, if not exterminate the bug.

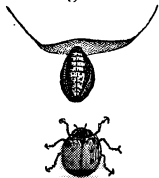
To this argument some may reply that the potato bug will feed on other species of the natural botanical family Solanaceæ, such as the tomato, thorn-apple, etc. It is true that they will eat of these to some extent, especially the hungry half-grown larvæ, but I have observed carefully, and never in this region saw the young potato bugs developing from the eggs laid on these plants, though I have occasionally seen eggs on tomato plants.

Early in the last spring a sufficient number of mature potato bugs appeared on the potato vines to cause some apprehensions of trouble, though much less than in the preceding year. The larvæ appeared as usual, and early potatoes were partially trimmed by them, from which I inferred that the second brood would do a good deal of damage in July and August.

About the middle of July I saw potato bugs in Minnesota, as far north as St. Paul. They were quite abundant, the larvæ stripping the vines as they had done in Illinois last year. I was at home in Illinois in August, and sought for the potato bugs on the same grounds that were entirely overrun by them last year, and found very few. At the last of August, I searched in the potato patch, on these same grounds, and found but two mature bugs and one small bunch of eggs. Here is a remarkable and unexpected decrease of bugs, instead of the usual increase, that makes them very destructive in August. How are we to account for it? The various known heteropterous enemies, and Lady-birds,

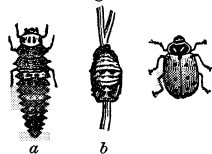
(Fig. 14, *Coccinella 9-notata* and pupa; fig. 15, *Hippodamia 13-punctata*; *a*, larva; *b*, pupa) without doubt destroyed some, but as I could not find them more numerous than usual,

Fig. 14.



I cannot admit that they were the chief means of this almost perfect extermination of potato bugs. Moreover the larvæ in June were sufficiently numerous, in proportion to the number of beetles observed in the spring, and yet in July and August the beetles failed to appear as expected. We can only look to climatic causes as the principal means that prevented the spring brood from maturing.

Fig. 15.



The weather here was uncommonly *hot* as well as dry, hence the pupæ were exposed to the burning dry dust, and this doubtless was the efficient cause of the death of the soft, naked, delicate pupæ. The only object that they can have in entering the ground to transform, is protection from the hot dry atmosphere of summer and the cold frosts of winter, for they will transform well enough above ground in a paste-board box in a room, as I proved in hundreds of examples during the series of observations I made on the breeding of these insects in 1865, and reported in the "Practical Entomologist." The ground usually furnishes a cool moist place, but this time it failed to favor them, hence they perished.

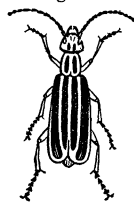
I have often observed that the pupæ of various insects perish from exposure to too much evaporation. The pupæ of the various wood-borers however, carefully handled, will not develop so well in a paper box as in the hole they make in the tree, and many of them dry away entirely; this I have often observed, and very forcibly this summer, in the examples of the new species of beetle, that I have bred from the prickly ash tree; also the three varieties of beetles, bred from the several borers, or "grubs," found in the grape-vine, reported to the Academy of Natural Sciences, Philadelphia. This same drying away of the pupa I have often noticed

in attempting to breed the Maple Worm (*Dryocampa rubicunda*). The larva retires to some cool moist place beneath a board, stone, or anything it can find on the ground, where it will not be exposed to the dry atmosphere, for the chrysalis is naked. Now take this same chrysalis and put it into a dry box, and it most likely will perish, and fail to perfectly develop. Many lepidopterous larvæ protect themselves with an impervious cocoon where they are exposed to atmospheric vicissitudes. This, I believe, is not only to protect them from the rain, if it is at all for this purpose, as entomologists often suppose, but to protect them from the far more injurious influence of evaporation during the long time they take no liquid nourishment. It is for this purpose also that the Cecidomyian larva cements its spun cocoon with a gummy fluid, as I have shown in the "Transactions of the American Entomological Society," for October, 1867. We therefore find here another example of climatic causes, producing disease and death among insects in a wholesale manner.

Entomological writers usually represent cannibal insects as the most efficient means in nature for the extermination of injurious insects, and in the reports of State Entomologists we occasionally find them speaking in glowing terms of the power that man can exert in controlling injurious insects. While we may not despise these measures of protection, especially the former—for without the Ichneumon fly, the Syrphus fly, the Coccinellæ, etc., we would doubtless be overrun by swarms of caterpillars, plant-lice, and other noxious depredators—let us not forget the great truth, that climatic causes, producing death by epidemic diseases and various other means, are infinitely in advance of most other natural means of exterminating noxious insects (for my extended views and observations on this topic, see an address before the Northern Illinois Horticultural Society, and published in the first volume of the Transactions of that body, and my Report of a remarkable epidemic disease observed among

Chinch-bugs, in the Proceedings of the Academy of Natural Sciences of Philadelphia, for May, 1867).

Fig. 16.



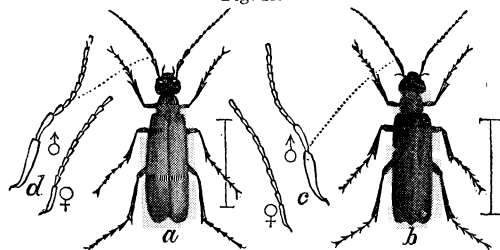
In the case of the Chinch-bug, the conditions favoring its development and health are entirely the reverse. It was during the unusually wet weather of 1865 that the great epidemic referred to prevailed, and at the same time the Colorado potato bug flourished and multiplied as favorably as it could desire;

Fig. 17.



but this year was one favorable to the development of the Chinch-bugs, and true to nature, they have increased so that a few can be found again. Since I observed this failure of development among the potato bugs, I have looked carefully for them in this (Carroll) and parts of the adjoining counties, and seldom find a patch with any bugs. At this date the early frosts have

Fig. 18.



already killed the potato vines, hence their autumnal supply of food being cut off we may expect a still more complete destruction of the bugs if

the next autumn should be nearly as pleasant as the last.

Of the Blistering Beetles (*Cantharidæ*), I have observed this year the Striped Cantharis (*Lytta vittata* Fabr., Fig 16) unusually abundant, and quite injurious to potato vines, beet leaves, etc. The Margined Cantharis (*Cantharis marginata* Oliver, Fig. 17) were also moderately abundant, injuring beets most. I also observed some of the Ash-colored Cantharis (*Lytta cinerea* Fabr., Fig. 18, *a*, male), and the black Cantharis (*Lytta murina* Leconte, Fig. 18, *b*) on potatoes and beets. A species of Oil Beetle (*Meloë angusticollis*, Fig. 19) was also abundant, eating potatoes, beets, etc., and injuring tomato fruit very much. Farmers all about

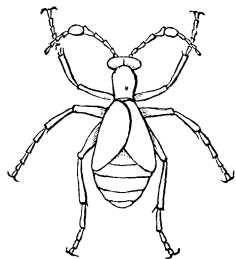
this region have complained bitterly of a "new long potato bug," alluding to these Cantharides, having forgotten in the midst of the injuries caused by the Colorado potato bugs for several years, that these blistering beetles had ever injured potato vines.

The reports coming in from localities all around me were that these Cantharides were much more injurious than the Colorado bugs; that potatoes were greatly injured, and beet crops entirely ruined in many instances; and this accords with my observations about home.

These Cantharides are not very particular about the choice of food. Although they doubtless prefer the potato, beet, golden-rod, etc., yet sooner than be without food, they will devour almost any kind of vegetable that comes in their way. I have seen the Ash-colored Cantharis doing well on locust leaves; also on common red field clover, etc., and have lately, for a wonder, seen the Black Cantharis feasting on the leaves of a common noxious weed, sometimes called lamb's quarters, pig-weed, etc. (*Chenopodium album* Linn.), for injurious insects are almost sure to eat the useful vegetation in preference to weeds.

After thus observing the workings of nature's plans, I am convinced that she will in due time take care of the Colorado potato bug, as she has of the Cantharides during all past time.

Fig. 19.



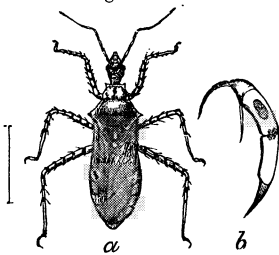
NOTE. — Since communicating the above, I spent two weeks last autumn in travelling in Eastern and Middle Iowa, and learned some facts, the most reliable being developed out of the history of the general good potato crop, as evinced by the price in the digging season. Potatoes at Mount Carroll, Ill., were 50 cents a bushel; at Morseville, Joe Davis County, Ill., 50 cents; at Rock Island, Ill., 60 to 70 cents. In Iowa, at South Amenon, 30 to 35 cents; at Marengo, 50 cents; State Centre, 30 to 35 cents; Grundy County, 25 to 30 cents; and thus prices ranged all along wherever I went. The Colorado potato beetle had been very injurious.

All through these places for several years farmers all were discouraged with attempting to raise potatoes, and therefore did not plant largely; some abandoned the crop in disgust. The above figures I obtained from parties buying and selling, and learned from them that potatoes were abundant.

I invariably inquired of farmers regarding the Colorado potato beetle. They all knew it very well, but explained the cause of its diminution, by supposing that it had passed by them, travelling north and east; forgetting that insects travel in search of food and breeding grounds, and not to make money, see the country or their friends, or for any other pleasure, as does the human animal. They all knew that the bugs were plenty in the spring, but not in midsummer and autumn. As this peculiar phenomenon in the history of the Colorado potato bug was the same as above noted at my home, I am persuaded that it was due to the same cause, in a slight degree to insect enemies, but chiefly to climatic causes, *i. e.*, the *hot dry weather*.

I am now convinced beyond a doubt, that the dryness of the summer was the only efficient restraining cause, although my friends Messrs.

Fig. 20.

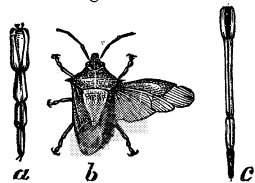


Walsh and Riley differ entirely from this view. See the "American Entomologist," (Vol. I, Nos. 2 and 3) where they figure quite a host of the enemies of the Colorado potato bug, some of which are inserted in the present article, but do not even notice the great climatic enemy that worked so faithfully and effectually everywhere during the past summer.

I appreciate with much gratitude the small part of the work done by these "bug foes,"

and I hope that the editors and authors will excuse a passing review. Lady-birds doubtless eat the eggs of some potato bug, but many such reports came to my ears through farmers and agriculturists and were not at all reliable. Unfortunately, as I have observed, Lady-birds will devour Lady-bird's eggs about as frequently as any other eggs, and none but entomologists observe the difference, hence I seldom notice such reports, at least in print, without personal investigation. The Many-banded Robber (*Harpactor cinctus* Fabr., Fig. 20) will not do much work, for, although they will eat some larval potato bugs (just as a cat will eat some bread) when hard pressed for food, yet they will perish of hunger when confined in a box with young Colorado potato bugs, as I have demonstrated, thus proving that they must have other and better food. The very same, probably, may be true (reasoning from analogy) of their other principal heteropterous enemy, the Spined Soldier-bug (*Arma spinosa* Dallas, Fig. 21; *a*, its beak; *c*, the beak of the *Euschistus punctipes* Say, which closely resem-

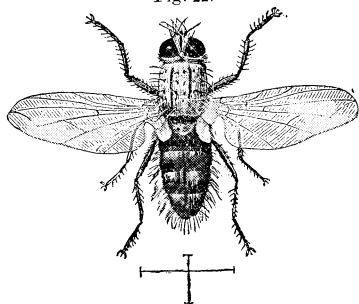
Fig. 21.



bles the *Arma*). This, however, I never have subjected to the crucial test of boxing up with the beetle, but have never seen it feeding on them in nature, nor found them more abundant in potato patches than elsewhere.

The authors, from their correspondents, publish as "no doubt indisputable," that the Blister Beetles frequently feed on potato bugs. This same idea entered my head when I saw the potato bugs so scarce, and the blister beetles, especially the striped one, so very abundant on our potatoes. To test it, I put a few Striped Blister-beetles into a breeding jar, with one small bunch of potato bug eggs (all I could find) and a potato stalk for food. The eggs hatched in a day, and the young Colorado bugs lived in harmony among their "formidable" associates, until the potato vine moulded away. The Blister-beetles perished first, of starvation, without destroying one of the larvæ. This little experiment, although

Fig. 22.



not as extended as I could wish, yet inclines me to be skeptical about the matter. Their parasitic fly (Fig. 22, *Tachina*) is entirely new to me, and I hope is a more important enemy than all the others. While I was breeding great numbers of potato bugs in 1865, preparatory to the paper I published in 1866, in the "Practical Entomologist," on this subject, I failed to find anything of this kind here; since then I have not searched for it. Their paper is full of interest, yet to the practical man does not give very much substantial encouragement except in recommending the old-fashioned tedious way of picking the bugs by hand, as in reality this is about all man can do.

Before closing this already long note, allow me to place among the list of insect enemies a *Philonthus* which is undescribed, according to Mr. Walsh, who received the specimen from me. This specimen, in the summer of 1865, I found as an intruder in one of my breeding boxes, containing a number of Colorado potato bug larvæ. When found, it had maliciously killed all the larvæ, just as a weasel or mink will kill more chickens than it needs for food. This insect was a medium sized member of the family *Staphylinidæ*, a *Brachelytrous* beetle. It was black, with short wing-cases. This fierce and powerful insect, individually, is the most terrible enemy of the Colorado potato bug extant among insects, and I hope that some day it will be honored with the name of the Prairie State, with credit for an efficient worker.

NOTE.—Cuts 13, 15, 16, 17, 18, 20, 21 and 22, are from the "American Entomologist."